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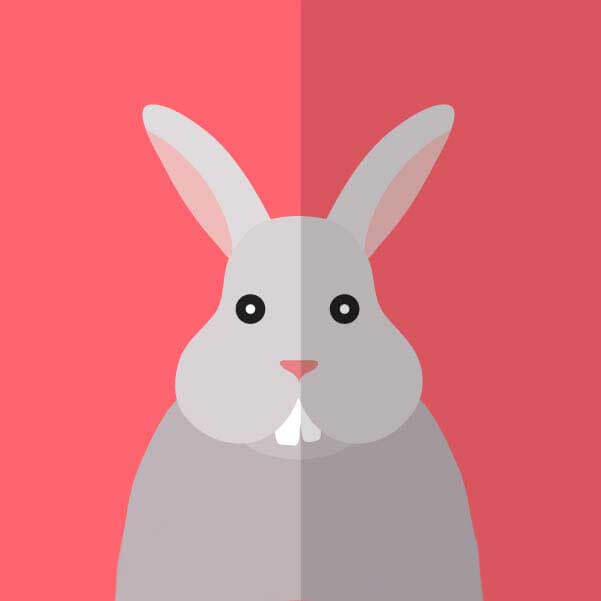
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**Android 8.1 build 编译系统介绍**

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**一 概述**

**1.1 编译系统变化**

从Android 7.0开始，android的编译系统发生了变化，之前依赖Makefile组织编译系统，从7.0开始逐步引入了kati soong(optional未正式使用，需要USE\_SOONG=true开启)，将Android.mk文件转化成ninja文件，使用ninja文件对编译系统进行管理。

从8.0开始，android 引入了Android.bp文件来替代之前的Android.mk文件，不同于Android.mk，Android.bp只是纯粹的配置文件，不包括分支、循环等流程控制。在android项目上如何进行选择编译、解析配置、转换成ninja等，Soong就被创造出来，将Android.bp转换为ninja文件进行管理。

同时，Soong还会编译长生一个androidmk命令可以手动将Android.mk转换成Android.bp文件。

**1.2 代码位置**

Kati的位置是在build/kati/中，平台也自带编译好的ckati

Soong的位置在build/soong,它和build/blueprint同时期作用，他们之间的系统关系如下：

Android.bp --> Blueprint --> Soong --> Ninja

Makefile or Android.mk --> kati --> Ninja

Blueprint是生成、解析Android.bp 的工具，是Soong的一部分。Soong是专门为Android的编译而设计的工具，blueprint只是解析文件的形式，而soong则解释内容的含义。

Blueprint和Soong都是有Go语言写的项目，从7.0开始在prebuilts/go/目录下新增了go语言的运行环境，在编译是使用。

**1.3 Android ninja组织**

在编译过程中，将所有的android.bp文件搜集成out\soong\build.ninja.d , 并以此为基础生成out\soong\build.ninja规则。

由所有的Android.mk生成build-aosp\_arm.ninja文件。通过combined-aosp\_arm.ninja将两个文件组织起来。

builddir = out

include out/build-aosp\_arm.ninja

include out/soong/build.ninja

build out/combined-aosp\_arm.ninja: phony out/soong/build.ninja

通过编译的LOG，首先搜集所有的bp文件生成build.ninja，然后搜集所有的mk文件生成build-aosp-arm.ninja文件。

out/soong/.bootstrap/bin/soong\_build out/soong/build.ninja

out/build-aosp\_arm-cleanspec.ninja is missing, regenerating...

out/build-aosp\_arm.ninja is missing, regenerating...

[1/894] including out/soong/Android-aosp\_arm.mk ...

经过试验表明，soong处理后的bp文件生成build.ninja的同时还包含out/soong/Android-aosp\_arm.mk，这个文件是编译完成后模块的安装脚本，负责将模块安装到对应位置。比如我们现在处理的vndk相关vendor处理就是在这个目录下进行的。

在out/soong目录下有两个文件.minibootstrap/build.ninja 和.bootstrap/build.ninja两个目录。.minibootstrap/build.ninja 主要是用来编译blueprint和生成.bootstrap/build.ninja。而.bootstrap/build.ninja主要是生成 soong相关工具和out/soong/build.ninja文件。

**二 编译流程**

**2.1 make 流程**

当我们在android 总目录下make时，默认寻找当前Makefile并找到all目标进行编译操作，这个是默认的make机制。当android更换为ninja是，在总目录下进行make时进行如何的流程呢。

同老的make机制一样，make找到总目录下的Makefile

$ cat Makefile

include build/make/core/main.mk

Makefile内容没有改变，同样是进入到main.mk中，刚开始几行有了明显的变化

ifndef KATI

host\_prebuilts **:=** linux-x86

ifeq ($(shell uname),Darwin)

host\_prebuilts **:=** darwin-x86

endif

.PHONY**:** run\_soong\_ui

run\_soong\_ui**:**

+@prebuilts/build-tools/$(host\_prebuilts)/bin/makeparallel --ninja build/soong/soong\_ui.bash --make-mode $(MAKECMDGOALS)

.PHONY**:** $(MAKECMDGOALS)

$(sort $(MAKECMDGOALS)) **:** run\_soong\_ui

@#empty

else # KATI

其中MAKECMDGOALS这个命名是make执行时后面的参数赋值，也就是我们执行任何make的时候都是执行run\_soong\_ui这个目标，这样android从Makefile切换为soong进行了编译流程，后面跟make就没有关系了。

**2.2 mm流程**

当我们单独编译某个模块时，在这个模块目录下输入mm命令进行编译，在build/envsetup.sh看一下具体实现过程：

function mm**()**

**{**

local T**=**$**(**gettop**)**

local DRV**=**$**(**getdriver $T**)**

# If we're sitting in the root of the build tree, just do a

# normal build.

**if** **[** **-**f build**/**soong**/**soong\_ui**.**bash **];** then

\_wrap\_build $DRV $T**/**build**/**soong**/**soong\_ui**.**bash **--**make**-**mode $@

**else**

ONE\_SHOT\_MAKEFILE**=**$M \_wrap\_build $DRV $T**/**build**/**soong**/**soong\_ui**.**bash **--**make**-**mode $MODULES $ARGS

流程上同make差不多只不过目标，是单独模块组成。

同时在mm一个单独模块是，生成独立的ninja文件

combined--aosp\_arm-frameworks\_native\_libs\_gui\_Android.mk.ninja 和

build- aosp\_arm-frameworks\_native\_libs\_gui\_Android.mk.ninja

**2.3 Soong流程**

在介绍soong编译流程之前，先介绍几个命令以便我们后续编译流程的理解，在out/soong/host/linux-x86/bin目录下，有几个命令是soong用到的，

soong\_ui: soong编译的入口

androidmk: 后面的Android.bp用到，Android.mk一键转换为android.bp

在out/soong/.bootstrap/bin目录下有几个

out/soong/.bootstrap/bin$ ls

bpglob gotestmain gotestrunner loadplugins minibp soong\_build soong\_env

minibp： 在bootstrap是用到

soong\_build ：这个很重要，主要是将bp文件转换为ninja文件

通过上文的分析，当我们make命令敲下去的时候，主要是执行

prebuilts/build-tools/$(host\_prebuilts)/bin/makeparallel --ninja build/soong/soong\_ui.bash --make-mode $(MAKECMDGOALS)

soong\_ui.bash脚本主要是执行如下：

[build\_go](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fdefs%253Dbuild_go%2526project%253Dsprdroid8.1_trunk) [soong\_ui](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fdefs%253Dsoong_ui%2526project%253Dsprdroid8.1_trunk) [android](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fpath%253Dandroid%2F)/[soong](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fpath%253Dandroid%2Fsoong%2F)/[cmd](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fpath%253Dandroid%2Fsoong%2Fcmd%2F)/[soong\_ui](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fpath%253Dandroid%2Fsoong%2Fcmd%2Fsoong_ui) //生成soong\_ui命令

cd ${[TOP](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fdefs%253DTOP%2526project%253Dsprdroid8.1_trunk)}

exec "$([getoutdir](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fdefs%253Dgetoutdir%2526project%253Dsprdroid8.1_trunk))/soong\_ui" "$@" //soong\_ui入口，执行soong流程

比如我们执行make systemimage，到这边就变成了soong\_ui –make-mode systemimage

soong\_ui代码在[build](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fxref%2Fsprdroid8.1_trunk%2Fbuild%2F)/[soong](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fxref%2Fsprdroid8.1_trunk%2Fbuild%2Fsoong%2F)/[cmd](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fxref%2Fsprdroid8.1_trunk%2Fbuild%2Fsoong%2Fcmd%2F)/[soong\_ui](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fxref%2Fsprdroid8.1_trunk%2Fbuild%2Fsoong%2Fcmd%2Fsoong_ui%2F)/[main.go](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fxref%2Fsprdroid8.1_trunk%2Fbuild%2Fsoong%2Fcmd%2Fsoong_ui%2Fmain.go) 下，主要流程如下：

func main() {

log := logger.New(os.Stderr)

defer log.Cleanup()

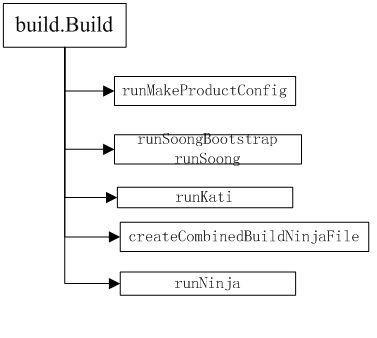
if len(os.Args) < 2 || !inList("--make-mode", os.Args) {

log.Fatalln("The `soong` native UI is not yet available.")

}

build.Build(buildCtx, config, build.BuildAll)

主要执行soong/ui/build/build.go，从build.go就可以看到执行soong的大体流程



看一下各个流程

Step 1: runMakeProductConfig 主要配置编译参数

Step 2: runSoongBootstrap 这个主要是为后面编译工具的使用 ckati soong做环境搭建

runSoong 对工具进行编译

/.minibootstrap/[build.ninja](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fpath%253Dbuild.ninja%2526project%253Dsprdroid8.1_trunk)

- Run minibp to generate .bootstrap/[build.ninja](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fpath%253Dbuild.ninja%2526project%253Dsprdroid8.1_trunk) (Primary stage) - Run minibp to generate .minibootstrap/[build.ninja.in](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fpath%253Dbuild.ninja.in%2526project%253Dsprdroid8.1_trunk)

/.bootstrap/[build.ninja](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fpath%253Dbuild.ninja%2526project%253Dsprdroid8.1_trunk)

- Build any bootstrap\_go\_binary rules and dependencies -- usually the primary builder and any build or runtime dependencies. - Run the primary builder to generate [build.ninja](https://link.jianshu.com/?t=http%3A%2F%2Flink.zhihu.com%2F%3Ftarget%3Dhttp%253A%2F%2F10.0.1.79%253A8081%2Fsource%2Fs%253Fpath%253Dbuild.ninja%2526project%253Dsprdroid8.1_trunk)

同时还会生成out/soong/build.ninja

Step 3: 运行step2生成的ckati，搜集所有的Android.mk文件生成ninja文件，也就是前面提到的 out/build-aosp\_arm.ninja

Step4: 将out/soong/build.ninja 和out/build-aosp\_arm.ninja 合成为combined-aosp\_arm.ninja

Step5： 运行runNinja 解释combined-aosp\_arm.ninja 运行编译过程

**三 ninja使用**

  我们可以使用ninja 和生成的combined-aosp\_arm.ninja 编译工程或者某一个module.

$ ./prebuilts/build-tools/linux-x86/bin/ninja -f out/combined-aosp\_arm.ninja

同在工程中make一个效果

编译systemimage或者bootimage

$ ./prebuilts/build-tools/linux-x86/bin/ninja -f out/combined-aosp\_arm.ninja  systemimage

上面这样做的目的是，不用重新生成ninja文件，直接进行编译，节省部分时间。这是在没有修改Makefile的前提下

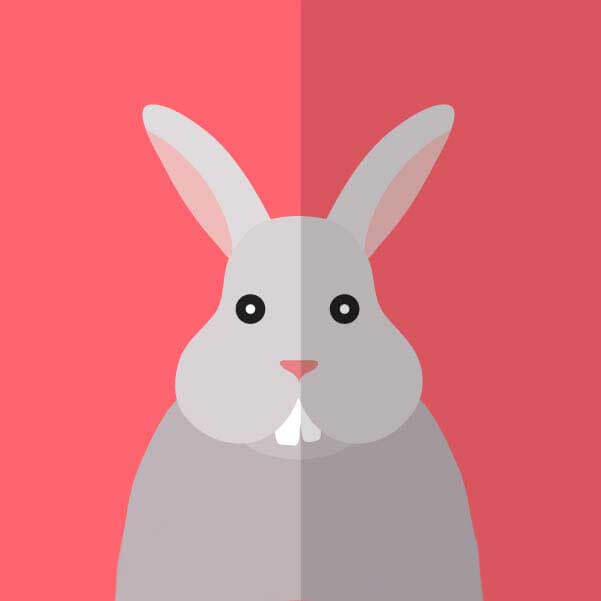
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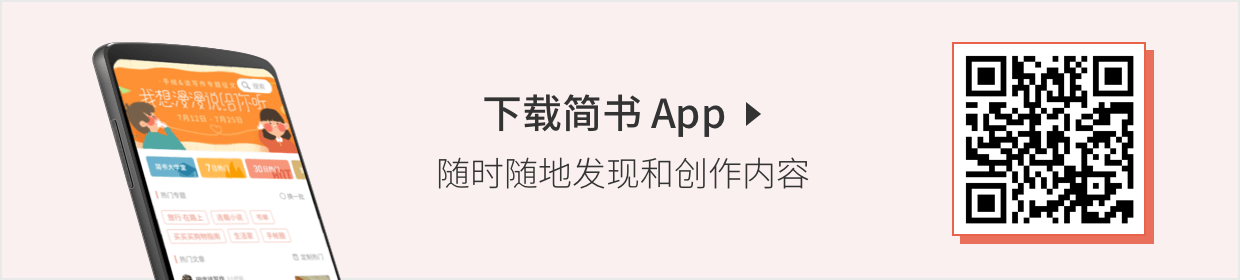
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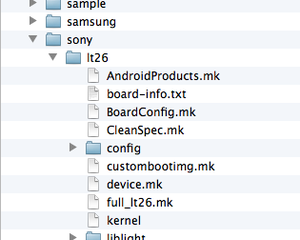
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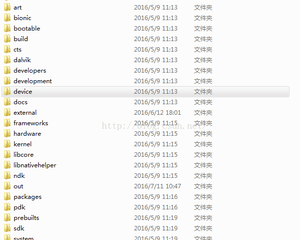
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赵姓，是中国姓氏通谱百家姓中的第一姓，其人口在全国姓氏中排名第七位，人口约有9000万，占全国总人口的7.5%。我们新化赵氏家族来源于两大支系。一支为始迁祖胜宗公支系，一支为《三宗五派》支系。 一、胜宗公支系。胜宗，浙江台州黄岩。明洪武时，因勤王有功，官至御前待卫千户指挥使...

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[新化龙山居士](https://www.jianshu.com/u/8c79f7cae444?utm_campaign=maleskine&utm_content=user&utm_medium=seo_notes&utm_source=recommendation" \t "_blank)

[](https://www.jianshu.com/p/856bfd18f0fc?utm_campaign=maleskine&utm_content=note&utm_medium=seo_notes&utm_source=recommendation)[**也许**](https://www.jianshu.com/p/856bfd18f0fc?utm_campaign=maleskine&utm_content=note&utm_medium=seo_notes&utm_source=recommendation)

也许，进入你的生活，不是我最好的选择。但是，路过你的全世界，放弃你的全世界，是我最坏的决定。那么，请让我，别路过，慢慢想，过了这辈子。 好吗？

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[圭靠](https://www.jianshu.com/u/3364922b3cd4?utm_campaign=maleskine&utm_content=user&utm_medium=seo_notes&utm_source=recommendation" \t "_blank)

[**绑架时光**](https://www.jianshu.com/p/b8ddac53f918?utm_campaign=maleskine&utm_content=note&utm_medium=seo_notes&utm_source=recommendation)

曾经，以为我们这一生很长很长，总会爱很多人 后来，才发现，不管时间如何张牙舞爪 最后，你记忆里所能铭记的爱人，其实只有两个 他爱你 你爱他 曾经，我们也深深的爱过一些人，爱的时候把朝朝暮暮当做天长地久，把浅倦一时当做被爱了一世。于是承诺，于是奢望执子之手。然而，随着时间流逝...

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[柳婼曦](https://www.jianshu.com/u/c9a0cb8c7a2e?utm_campaign=maleskine&utm_content=user&utm_medium=seo_notes&utm_source=recommendation" \t "_blank)

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清明时节雨纷纷，现在的你是否会怀念起自己小时候跑过的老街呢？今天给大家带来我的新作品，希望大家喜欢！ 第一步铅笔打底，注意透视关系哦！物体之间的比例关系一定要把握好，让自己的作品大概有一个轮廓，一定要反复检查哦，因为打底是整个作品的基础工作。 打好底就可以按部就班地填色啦，...

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[剑雪浮屠](https://www.jianshu.com/u/896ae7e60139?utm_campaign=maleskine&utm_content=user&utm_medium=seo_notes&utm_source=recommendation" \t "_blank)

[**读《我们仨》，向钱锺书杨绛夫妇学习教育孩子**](https://www.jianshu.com/p/82a69a79eb82?utm_campaign=maleskine&utm_content=note&utm_medium=seo_notes&utm_source=recommendation)

家庭教育自古以来一直受到有识家长的重视，大家耳熟能详的“孟母三迁”、“曾子杀彘”的故事，就是家庭教育的典范。孩子是家庭的未来和希望，家长希望自己的孩子能够“青出于蓝而胜于蓝”，都会以己所能、尽己之力去教育孩子。 当今时代，家庭教育更是得到前所未有的重视，家长们想方设法要把孩...

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